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NASA TECH BRIEF

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Carrier Extraction Circuit

The problem:

In a phase shift keyed (PSK) system, a carrier reference is needed for demodulation. Frequently, a separate reference signal is transmitted, but this requires additional transmission power.

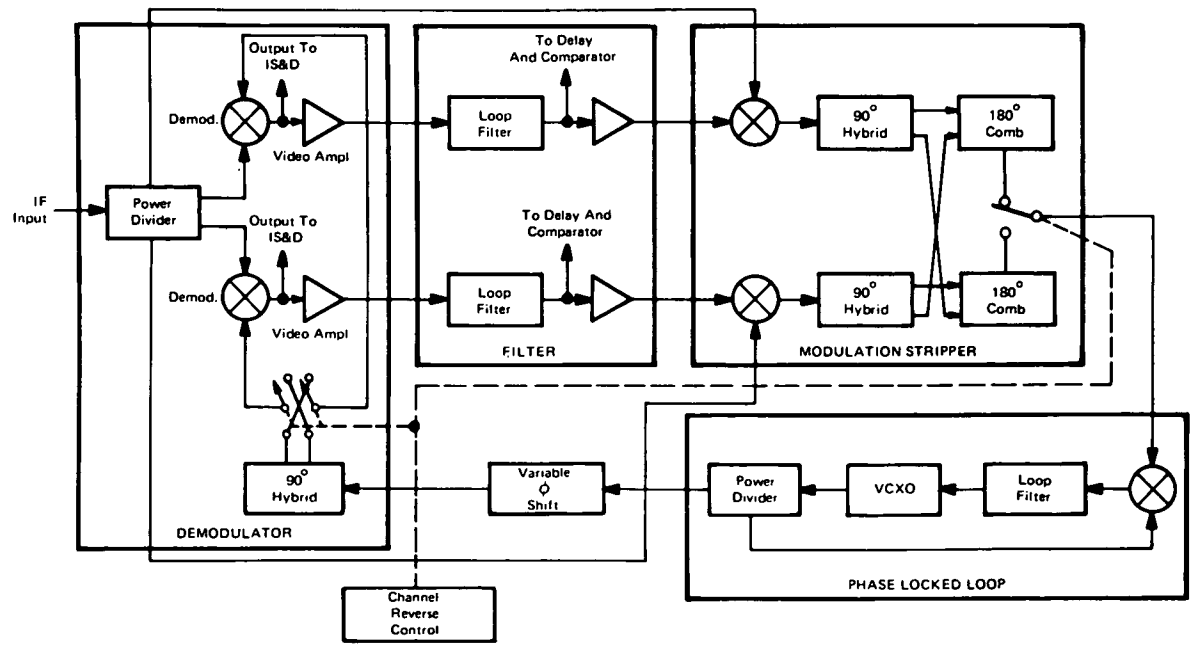
The solution:

From the IF input, a feedback loop extracts a demodulated reference signal that is fed back to the demodulator. Since the reference signal is extracted directly from the carrier, no separate reference need be transmitted. This circuit can obtain a coherent carrier from a balanced or unbalanced four-phase signal of widely varying characteristics.

How it's done:

The flow of the principal signals in the feedback loop is shown in the accompanying block diagram. The loop consists of four main parts: (1) a demodulator circuit containing two separate coherent demodulators, one producing the in-phase component and the other the quadrature, (2) a filter which removes the high-frequency noise component, (3) a modulation stripper, where each filtered data stream separately remodulates the incoming quadriphase signal and is recombined to produce an unmodulated but noisy carrier, and (4) a phase locked loop which cleans up the unmodulated carrier for input back into the modulator.

The Demodulator. The incoming modulated IF signal first enters the feedback loop through the power divider where it is split into four equal parts. Two go to the



Carrier Extraction Loop Functional Block Diagram

(continued overleaf)

demodulators, and two to the modulator stripper. One of the demodulators uses the in-phase component of the reference, and the other uses the quadrature component. The demodulated signals are provided to integrate, sample, and dump (IS&D) circuits for detection of the binary data streams and are amplified in parallel and fed into the filter circuit.

Filter. The filter circuit employs plug-in loop filters from which the signals are applied to comparators to obtain a binary data output for each channel.

Modulation Stripper. The data now go to mixers in the modulation stripper where they are combined with the original IF signal from the power divider. The resulting signal is partially demodulated. Upon recombining the two channels in the proper phase and amplitude relationship, the modulation components cancel, and a carrier component in phase with one of the two original components is generated.

Phase-Locked Loop. The extracted carrier from the modulation stripper is compared to the voltage-controlled crystal oscillator (VCXO) output in the mixer. The error signal is filtered and applied to the VCXO voltage control. The VCXO output is split, one part going back to the mixer, and the other becoming the coherent reference signal input to the demodulator.

It should be noted that there are two possible ways to combine the signal making up the modulator stripper output. The correct combination is selected and synchronized with the selection of channels in the demodulator by the channel reverse control.

In this system, both channels can be operated at different power levels, and the channels may be at different bit rates. The circuit has been successfully tested and can handle data rates from 1 KBPS to 30 MBPS.

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)], to the RCA Corp./Government and Commercial Systems, Camden, New Jersey 08102.

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